

Claims

- [c1] 1. A method for processing of a multi-dimensional dataset corresponding to an imaging volume, the method comprising:
accessing the multi-dimensional dataset;
generating a plurality of differential operators for the multi-dimensional dataset using a discrete approximation of an analytic function; and
forming a plurality of geometric responses based on a plurality of differential operators resultant from said generating.
- [c2] 2. The method of Claim 1 further including scale-space processing the multi-dimensional dataset with multi-resolution sampling.
- [c3] 3. The method of Claim 2 further comprising:
iterating said generating and forming over several scales to determine said plurality of responses for each scale;
and
determining said plurality of geometric responses based on said iterating.
- [c4] 4. The method of Claim 1 wherein said computing fur-

ther includes:

filtering the multi-dimensional dataset with a smoothing kernel based on an analytic function; said smoothing kernel generating a filtered multi-dimensional dataset.

- [c5] 5. The method of Claim 1 wherein said analytic function is a Gaussian.
- [c6] 6. The method of Claim 1 wherein said plurality of differential operators correspond to an n -th derivative of said analytic function, where n is greater than or equal to one.
- [c7] 7. The method of Claim 1 wherein said computing comprises:
 - identifying a plurality of discrete derivative approximations that when convolved with said analytic function, approximates an analytical derivative of said analytic function; and
 - optimizing said discrete derivative approximations in a least squares sense to reduce an error between said plurality of discrete derivative approximations and said analytical derivative of said analytic function.
- [c8] 8. The method of Claim 1 further including isolating a selected region of interest from the multi-dimensional dataset; said selected region of interest comprising a

subset of the imaging volume.

[c9] 9. The method of Claim 8 wherein said isolating a selected region of interest includes image threshold filtering and a morphology process configured to eliminate selected portions of the imaging volume.

[c10] 10. The method of Claim 8 and wherein said isolating a selected region of interest further includes isolating lung tissue for a pair of lungs comprising:
filtering with a high threshold algorithm to isolate solid tissue and bone;
filling holes with a three-dimensional hole filling algorithm to fill a portion of remain contained inside said solids;
filtering with a low threshold algorithm to isolate parenchyma of a pair of lungs from the solid tissue and bone;
splitting and isolating said pair of lungs with a morphology erosion algorithm;
closing and filing airways and vascular structures entering said pair of lungs with a morphology closure algorithm; and
filling remaining holes with a three-dimensional hole filling algorithm to yield another multidimensional dataset corresponding to the selected region of interest.

- [c11] 11. The method of Claim 3 further including generating a downsampled multidimensional dataset based on said multi-resolution sampling.
- [c12] 12. The method of Claim 11 further including isolating a selected region of interest from at least one of said multi-dimensional dataset and said downsampled multi-dimensional dataset, said selected region of interest comprising a subset of the imaging volume.
- [c13] 13. The method of Claim 11 wherein said isolating a selected region of interest includes image threshold filtering and a morphology process configured to eliminate unnecessary portions of the imaging volume.
- [c14] 14. The method of Claim 1 wherein said processing of a multi-dimensional dataset is executed in less than one minute.
- [c15] 15. A method for processing of a multi-dimensional dataset corresponding to an imaging volume, the method comprising:
processing the multidimensional dataset with multi-resolution sampling to establish a downsampled multidimensional dataset;
identifying a region of interest from the multi-dimensional dataset; said region of interest comprising a

subset of the imaging volume;
processing said downsampled multidimensional dataset based on said region of interest and establishing a multi-dimensional datasubset;
filtering the a multi-dimensional datasubset with a smoothing kernal based on an analytic function; said smoothing kernal generating a filtered multi-dimensional datasubset;
generating a plurality of differential operators for the multi-dimensional datasubset using a discrete approximation of an analytic function; and
forming a plurality of geometric responses based on a plurality of differential operators resultant from said generating.

- [c16] 16. A method for processing of a multi-dimensional dataset in a multi-resolution framework comprising:
isolating a selected region of interest from said multidimensional dataset and establishing a multidimensional datasubset, said selected region of interest comprising a subset of the imaging volume;
convolving said multidimensional datasubset with an analytic function to obtain a first convolution product;
determining a plurality of discrete derivative approximations to an analytic function and optimizing said discrete derivative approximations in a least squares sense to re-

duce an error between said plurality of discrete derivative approximations and an analytical derivative of said analytic function;
convolving said first convolution product with the plurality of discrete approximations of partial derivatives of an analytic function to create a plurality of second convolution products;
forming a plurality of Hessian matrices from said plurality of second convolution products;
determining a plurality of eigenvalue decompositions for said plurality of said Hessian matrices; and
combining eigenvalues resultant from said decompositions to represent spherical and cylindrical responses to elements of said multidimensional dataset.

- [c17] 17. A system for processing of a multi-dimensional dataset corresponding to an imaging volume, the system comprising:
a means for accessing the multi-dimensional dataset;
a means for generating a plurality of differential operators for the multi-dimensional dataset using a discrete approximation of an analytic function; and
a means for forming a plurality of geometric responses based on a plurality of differential operators resultant from said generating.

[c18] 18.A system for processing of a multi-dimensional dataset corresponding to an imaging volume, the system comprising:

- an imaging system comprising;
- a radiation source configured to generate a radiation beam incident upon an object,
- a radiation detector, said radiation detector configured to receive an attenuated radiation beam responsive to said radiation beam incident upon said object and produce an electrical signal responsive to an intensity of attenuated radiation beam, and
- wherein said radiation source and said radiation detector disposed about an object cavity;
- a processing device in operable communication with said radiation detector configured to execute a method for processing of a multi-dimensional dataset corresponding to an imaging volume, the method comprising;
- accessing the multi-dimensional dataset,
- generating a plurality of differential operators for the multi-dimensional dataset using a discrete approximation of an analytic function, and
- forming a plurality of geometric responses based on a plurality of differential operators resultant from said generating.

[c19] 19.A computer data storage device, said computer data

storage device including computer readable program code, the computer readable program code comprising a method for processing of a multi-dimensional dataset corresponding to an imaging volume, the method comprising:

accessing the multi-dimensional dataset;

generating a plurality of differential operators for the multi-dimensional dataset using a discrete approximation of an analytic function; and

forming a plurality of geometric responses based on a plurality of differential operators resultant from said generating.

[c20] 20.A computer data signal, said data signal comprising code configured to cause a processing device to implement a method for processing of a multi-dimensional dataset corresponding to an imaging volume, the method comprising:

accessing the multi-dimensional dataset;

generating a plurality of differential operators for the multi-dimensional dataset using a discrete approximation of an analytic function; and

forming a plurality of geometric responses based on a plurality of differential operators resultant from said generating.

[c21] 21. A computer program code embodied in a computer readable form configured to cause a computer to implement a method for processing of a multi-dimensional dataset corresponding to an imaging volume, the method comprising:

- accessing the multi-dimensional dataset;
- generating a plurality of differential operators for the multi-dimensional dataset using a discrete approximation of an analytic function; and
- forming a plurality of geometric responses based on a plurality of differential operators resultant from said generating.